

Consider the case of an able schoolboy who makes mathematics his chief study between the ages, say, of fifteen and nineteen; this period should suffice to give him a working knowledge of three-dimensional analysis, integral calculus and differential equations with their applications to the mechanics of solids, in addition to the subjects now required by the colleges, were it not for certain side issues which have arisen from the latter and assumed stupendous proportions. Foremost among these stands the excessive measure of attention given to the analysis of curves of the second degree. These form naturally a small section in a treatise on analytical geometry; yet while the far-reaching principles of the latter are lightly passed over, there is scarcely a method so abstruse or an artifice so petty that it may not give rise to a question in an entrance scholarship paper if its bearing be upon conic sections; so that no less than a third of a schoolboy's mathematical hours are frequently sacrificed to these curves. Their real interest is due, firstly, to their appearance in astronomy (the properties there required are few, and might be treated in the appendix of a text-book on dynamics), and, secondly, to their adaptability to treatment by pure geometry, the direct methods of which lend them an interest which is alien to every other branch of mathematics, and supply a mental discipline which is elsewhere unattainable. On this alone rests their title to rank as a separate subject.

But this, though the most aggravated, is not the only instance of the kind. The time spent on advanced trigonometry is out of all proportion to its practical or educational value; the subject contains an introduction to the use of the complex quantity which properly forms part of the theory of functions, and includes a number of highly specialised problems which have no place in a syllabus so elementary as to exclude the integral calculus. A similar waste is caused by several large classes of questions, especially some on series, the ability to solve which implies nothing but an effort of memory, and by other fragments of high subjects which are thrust upon boys at an early stage and made artificially difficult by isolation from their proper context.

The above criticisms are not made in any spirit of hostility to examiners, who in framing their papers are trying to obviate the shortcomings of a system which is out of date and in need of radical reform. Five decades ago it was doubtless advisable, in view of the then state of school mathematics, to limit the entrance scholarship course to a few subjects, but under new and improved conditions is not an extension of syllabus preferable to the interweaving with these of a quantity of matter which, valuable as it may be to the problem setter, is for the student little else than a barrier to his progress?

But if the examinations in mathematics and science are to be brought into harmony, it is not only in the former that a new regime is needed. Under present conditions a boy could learn at school nearly the whole of the mathematics necessary for an advanced physical course. But to do this would jeopardise his chance of obtaining a first class in the science tripos unless the authorities recognised the value of his mathematical training by a substantial equivalent of marks, so that he might make a mathematical entrance scholarship the preliminary to a science course. For those who have not a taste for theory it would still be possible to adopt an experimental regime from the outset, though it is questionable whether they could in the long run bear comparison with men who had cultivated a faculty which it is no exaggeration to call a sixth sense. The glory of Cambridge and her highest traditions are centred in the names of her mathematical physicists. But the environment which surrounded Maxwell and Kelvin no longer exists. And to-day the growth of subjects and the consequent tendency to specialisation have gone far to materialise the phantom barrier which separates the practical from the theoretical, and have laid on the authorities the burden of creating a new system which shall be capable of reproducing the giants of the past.

Dulwich College, March 13.

C. A. RUMSEY.

#### The Morphology of Pleuronectidæ.

IN the *Memoir* on the Plaice by Messrs. Cole and Johnstone, reviewed in NATURE of March 20 (p. 459), there is a reference to Steenstrup's work on the metamorphosis of Pleuronectidæ which I think the reviewer would have done well to correct. The statement to which I refer is the following:—"This supposition (that the left eye passed through the substance of the head to reach the ocular side), absurd as it may seem to us now, was in fact believed by such an observer as Steenstrup."

The truth of the matter is that Steenstrup did not believe any supposition, absurd or otherwise, on the subject, but stated from actual observation that in certain larval Pleuronectidæ the eye of one side passed through the tissues of the head and emerged on the other side. The form in question was long known as *Plagusia*, and is now known to be the larva of *Rhamboldichthys*. The truth of Steenstrup's observations was fully confirmed by Alexander Agassiz at Newport, R.I.

On the other hand, in the "Story of Life in the Seas," by Prof. S. J. Hickson, it is stated that in the young of the soles the eye of one side passes through the head to the other side. This is equally incorrect.

Messrs. Cole and Johnstone also state that the Gadidæ are the nearest relatives of the Pleuronectidæ, and promise to show that the morphological differences between the cod and the plaice, apart from the question of symmetry, are comparatively few and unimportant. I cannot find in the *Memoir* that they have redeemed this promise, and the morphological similarity of the two forms is contradicted by the authors themselves on p. 185 of the *Memoir*. I believe it could be shown by proper investigation that the morphological differences between these two fish are numerous and profound.

I think some explanation was due from the reviewer concerning Dr. Woodward's "startling discovery" that in Cretaceous times Teleostei of the Clupeoid type had already translocated the pelvic fin into the jugular position. I have not yet had the pleasure of seeing Dr. Woodward's latest volume, but a Clupeoid with jugular fins seems to me indeed a startling discovery.

Penzance, March 22.

J. T. CUNNINGHAM.

WHEN writing I was well aware that the sentence Mr. Cunningham quotes was not happily construed, but seeing that comment (like that of Mr. Cunningham himself) would needs be hypercritical, I allowed the matter to pass, in consideration of the context and of the desire to keep my review within bounds.

Concerning the Cretaceous teleostean described by Dr. Smith Woodward, I can only express my surprise that Mr. Cunningham should be so neglectful of the current literature of his subjects as to be unaware of its occurrence. With the rest of his letter I have no concern.

THE WRITER OF THE REVIEW.

#### Sun Pillars.

I HAVE been deeply interested in the correspondence in NATURE bearing on the appearance of sun pillars, and particularly so in the communication of Prof. Johnstone Stoney (p. 465).

The display of March 6 mentioned by the Rev. Guy Bridges and Mr. W. A. Knight was not visible here; but a very noteworthy occurrence of the phenomenon took place here on December 3 last and another on January 7 last, and there was one feature common to both of these events which has not been mentioned as occurring in relation to those recorded by other observers, so far as I am aware, but which seems to me to be a prime factor in the causation of the phenomenon under consideration, and it is this:—Before, and after, the actual time of the setting of the sun, during my own observations, there was a strong display of cirrus cloud in the "true cirrus" form of parallel bars, which appeared to run at right angles to the track of the setting sun, and roughly parallel, of course, to the horizon. As the setting sun neared the horizon, these bands of cloud became magnificently iridescent, displaying the spectrum colours of the rainbow, with the red nearest the horizon. As the sun set further the colours faded, beginning first at the red and following on in succession to the violet until this colour alone remained visible. Then ascended a beautiful pillar of a violet colour in exquisite shades, ascending gradually to a height of somewhere about twenty degrees above the horizon and then fading away slowly.

It seemed to me that the occurrence depended on (a) the presence of cirrus cloud (ice spiculæ); (b) these clouds must be in a banded or striated form; (c) they must lie at right angles to the track of the sun; and (d) these clouds must, of course, be present in the immediate neighbourhood of the setting sun. There are, besides, certain atmospheric conditions which seem to be desiderated in order to favour opacity, as dryness of the air, with calmness in its movements, and, I believe, a comparatively high barometric pressure. At the time of my

observation of December 3, the relative humidity of the air was 75 per cent., the wind calm, and the barometer, corrected to 32° and sea-level, 30.284 inches. On January 7, relative humidity was 76.5 per cent., wind faint; barometer 30.499 inches. The altitude of this station is 480 feet; lat. 54° N., long. 1° 36' W. G. PAUL.

Corporation Observatory, Harrogate, March 24.

THE sun pillar described by your correspondents was very well seen from the railway between Netley (5.40) and Southampton (6 p.m.), and lasted, I think, more than half an hour. It was visible before and after sunset. The upper air at the time was remarkably calm; the morning had been foggy, and the morning of March 7 was also foggy on the ground. Observation of the upper clouds on the morning of the 6th, and at the time of the phenomenon, showed an extremely slow movement from the north-west, barely noticeable between telegraph wires overhead. At 9 a.m. on the 7th cirrus was moving very slowly from about north, and at noon from north-west.

R. RUSSELL.

Condercum, Alum Chine, Bournemouth, March 24.

THE accounts of this rather rare phenomenon (as it seems to be) come (so far) only from the south-west of England. It is, therefore, worth while adding the following as seen at Oxford by myself and friends:—

March 6, 6.18 p.m.—A vertical pillar of flame-coloured light, springing probably from the sun below the horizon, quite parallel-sided, about  $\frac{3}{4}$ " wide and 6" high, careful measurements, perfectly steady for the 10 minutes that we were able to look that way. We thought there was a condensation of light, as of a faint mock sun, about 4" above the horizon. It was fading off downwards appreciably at the last moment.

Littlemore, Oxford.

W. J. HERSCHEL.

If the phenomenon of so-called "sun pillars" can only obtain when the atmosphere is "quite free from convection currents . . . (which it seldom is)" [see NATURE, March 20], is it not reasonable to suspect that the thing seen on March 6 was *not* such an atmospherical phenomenon? since it was viewed east and west from Brighton to the Cornish coast and northwards to High Barnet and Carmarthen Bay, so far as has been already ascertained.

If the barometrical and thermometrical readings, wind velocities and directions over this wide area on the 5th, 6th and 7th inst. could be obtained, an examination of these would go far to settle the question. CATHERINE O. STEVENS.

Bradfield, Berks, March 31.

#### Sounds Associated with Low Temperatures.

THE whistling or squeaking of snow under foot at low temperatures is a familiar phenomenon to residents in such climates as that of Canada. The sound is in strong contrast to the crunching of snow at the freezing point.

I suspect that "walking about the sheds" in the letter quoted by Sir Wm. Preece (p. 487) means walking over snow-covered ground between the sheds. J. D. EVERETT.

11 Leopold Road, Ealing, March 29.

I HAVE, I think, frequently heard the sounds mentioned in the letter sent to you by Sir William Preece; but if the sounds I mean are the same as those there described they are not necessarily associated with low temperatures, though they would be more likely to be noticed when the ground is frozen. The sounds to which I refer are to be heard near palings or sheds made, as they frequently are, with overlapping boards. The explanation I have always supposed to be as follows:—If the ground is sharply struck, with the boot for instance, the sound thus made will be reflected back by the ends of the boards; as each of these ends is further from the listener than its neighbour, the echoes will come back at intervals depending on the distance of the observer from the paling and on the width of the boards; if the boards are of equal width, the echoes will come back with nearly equal intervals between them, thus producing a musical note. If the ground is frozen, the sharp sounds necessary will be produced when walking by one's boot

striking the ground; but the same sounds may be produced in dry weather and especially when walking on gravel. I have often observed the musical note, but never where such an explanation would not be possible. Wooden palings are not, however, necessary; I have heard the same thing when walking past iron palings, more particularly, as is to be expected, when the uprights have a square section. CHARLES J. P. CAVE.

Binsted, Cambridge, March 31.

#### CENTRAL AND SOUTH AMERICA.<sup>1</sup>

CENTRAL AMERICA and the West Indies are attracting so much attention at present that a comprehensive description of them is of especial value to all who are watching the growth of political power in the New World. Hence we may welcome Mr. Keane's work, which, *inter alia*, treats of their history, physical geography, climate, flora, fauna, ethnology and industries, as well as of their financial and commercial statistics. The volume, although purporting to be a "new issue," might well claim to have no relation to the old one, edited, a quarter of a century ago, by the well-known naturalist H. W. Bates; for the knowledge of the region which has accumulated during the interval has been largely utilised, although not brought up to date in some important respects. Besides ten carefully executed maps, not overloaded and confused by unimportant names, the work contains numerous illustrations.

Mr. Keane opens his subject with a comprehensive chapter on the physical and biographical relations of the countries under consideration. "The present Central American mainland, like the Southern continent, formed, originally, a vast insular region, which was gradually consolidated in Tertiary and later times. It constituted a great archipelago, which stretched, for about 770 miles, in a south-easterly direction from Tehuantepec to Panama, and presented certain analogies to the West Indian insular world, with which it is in fact connected by at least two chains of islets, reefs, and partly or wholly submerged marine banks. . . . It is difficult to realise the fact that the 'American Mediterranean,' as the Gulf of Mexico and Caribbean Sea are often called, has a circuit from Cape Sable round to the Bahamas of no less than 12,000 miles. . . . The volume of water (the Gulf Stream) rejoining the equatorial current north of Florida strait, though relatively small, forms none the less a liquid mass about fifty-five miles wide and 450 fathoms deep moving at the rate of from two to six miles an hour, and is thus equivalent to as many as 300,000 rivers as copious as the Mississippi." It may be remarked that Maury is contented with giving the flow of the Gulf Stream through this strait as 1000 times the volume of the mighty river mentioned.

Mr. Keane discusses at length the ethno-geographical relations of the almost numberless tribes which have made the lands bordering the Gulf of Mexico and Caribbean Sea such an interesting study, and he concedes to the Toltec, Aztec and Maya peoples a high degree of civilisation. Most writers do the same, as they let their imagination revel in the romantic accounts of the conquest of Mexico and the descriptions of the ruins found from New Mexico to Panama; but it may be doubted if any of the tribes of Indians who occupied that region ever reached a higher grade than the "Upper Status of Barbarism" so admirably defined by Lewis H. Morgan in his "Ancient Society."

As to the Carib race, the cradle of which Mr. Keane rightly fixes in the heart of South America, they wandered north to the shores of the Caribbean Sea, to which they gave their name, and which recognised, throughout its

<sup>1</sup> Stanford's "Compendium of Geography and Travel" (new issue). "Central and South America." Vol. ii. Central America and West Indies. By A. H. Keane, F.R.G.S. Edited by Sir Clements Markham, K.C.B., F.R.S. Pp. xxiv+496. (London: E. Stanford.) Price 15s.